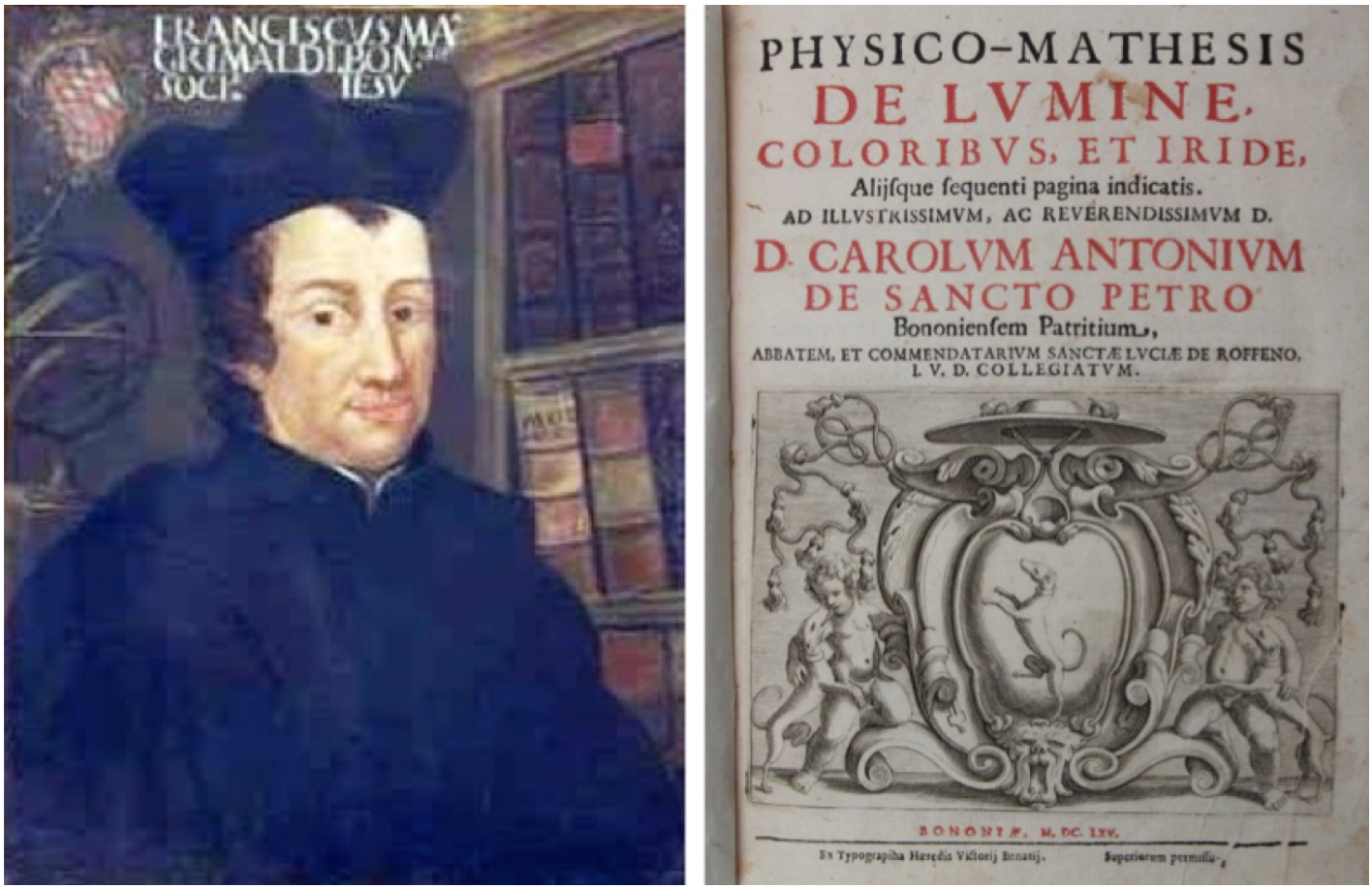
International Year of Light Blog

Other Anniversaries celebrated during the International Year of Light 2015

JULY 21, 2015JULY 17, 2015 LIGHT2015 3 COMMENTS

As we all no doubt know 2015 has been chosen to be "The International Year of Light and Light-based Technologies" because the anniversaries of a series of outstanding achievements in the history of the science of light are commemorated this year. One thousand years ago, in 1015, Alhazen published his works on optics. Two hundred years ago, in 1815, Fresnel proposed his notion of light as a wave and in 1865 Maxwell developed the electromagnetic theory of light, thereby unifying light, electricity and magnetism through "Maxwell's synthesis". Einstein explained the photoelectric effect in terms of quanta of light in 1905 and a century ago, in 1915, light was embedded in cosmology through his general relativity theory. Fifty years ago in 1965, Penzias and Wilson discovered the cosmic microwave background, an echo of the origin of the universe and evidence of the Big Bang, while 1965 was also the year of Kao's achievements concerning the transmission of light in optic fibres, which formed the basis of today's ubiquitous optical communication.

However, there are many other achievements related to light and its technologies, perhaps not as important as those above but which are also worthy of mention. With this in mind I decided to write this article. My first thought was to find other important achievements in the science and technology of light in the same years: 1015, 1815, 1865, 1905, 1915 and 1965. However, I immediately ruled out 1015 and chose the year 1665 instead, that is 350 years ago. In the case of 1965, I also set out to find two achievements similar to those mentioned above: an accidental discovery like the cosmic microwave background and a technological achievement like optical fibres. Below is my list of these "other anniversaries".



(https://light2015blogdotorg.files.wordpress.com/2015/07/figure-1.jpg)
Francesco Maria Grimaldi published the treatise titled Physicomathesis de lumine, coloribus, et iride, aliisque annexis. Credit: Wikipedia.

In 1665, exactly 350 years ago, the Italian physicist and Jesuit priest, **Francesco Maria Grimaldi** (https://en.wikipedia.org/wiki/Francesco_Maria_Grimaldi) (1618-1663) published the treatise titled *Physicomathesis de lumine, coloribus, et iride, aliisque annexis* (Physical understanding of light: colours of the rainbow), which gave him a prominent place in the history of optics. He was the first to make accurate observations on the **diffraction** of light and in fact coined the term *diffraction*. Grimaldi allowed rays of sunlight to enter a dark room through a small hole in a piece of cardboard. The light then passed through a carefully measured hole in another piece of cardboard and he discovered that the light projected a larger image than was to be expected if it moved in a rectilinear path.

Moving on to the year 1815, in which the Frenchman Augustin Fresnel proposed his wave theory of light, another Frenchman, **Jean-Baptiste Biot** (https://en.wikipedia.org/wiki/Jean-Baptiste_Biot) (1774-1862) accidentally discovered that certain natural organic substances such as turpentine, solutions of sugar, camphor and tartaric acid, exhibited the phenomenon of **optical activity**, that is the "polarization plane" of linearly polarized light is rotated when a light beam propagates through these liquids. This may be used, for example, to measure the concentration of sugar in solution. Biot proposed new experimental laws of optical activity and in 1815 published the article *Phénomènes de polarisation succesive, observés dans des fluides homogènes*, while in 1825 it was actually Fresnel who explained the mechanism of optical rotation. Biot taught Louis Pasteur (1822-1895) –the French chemist famous for discovering pasteurization and the rabies vaccine– who also studied the optical activity of dilute dielectric media.

(https://light2015blogdotorg.files.wordpress.com/2015/07/figure-2.jpg)
Jean-Baptiste Biot (left) and Émile Verdet (right). Credit: Wikipedia.

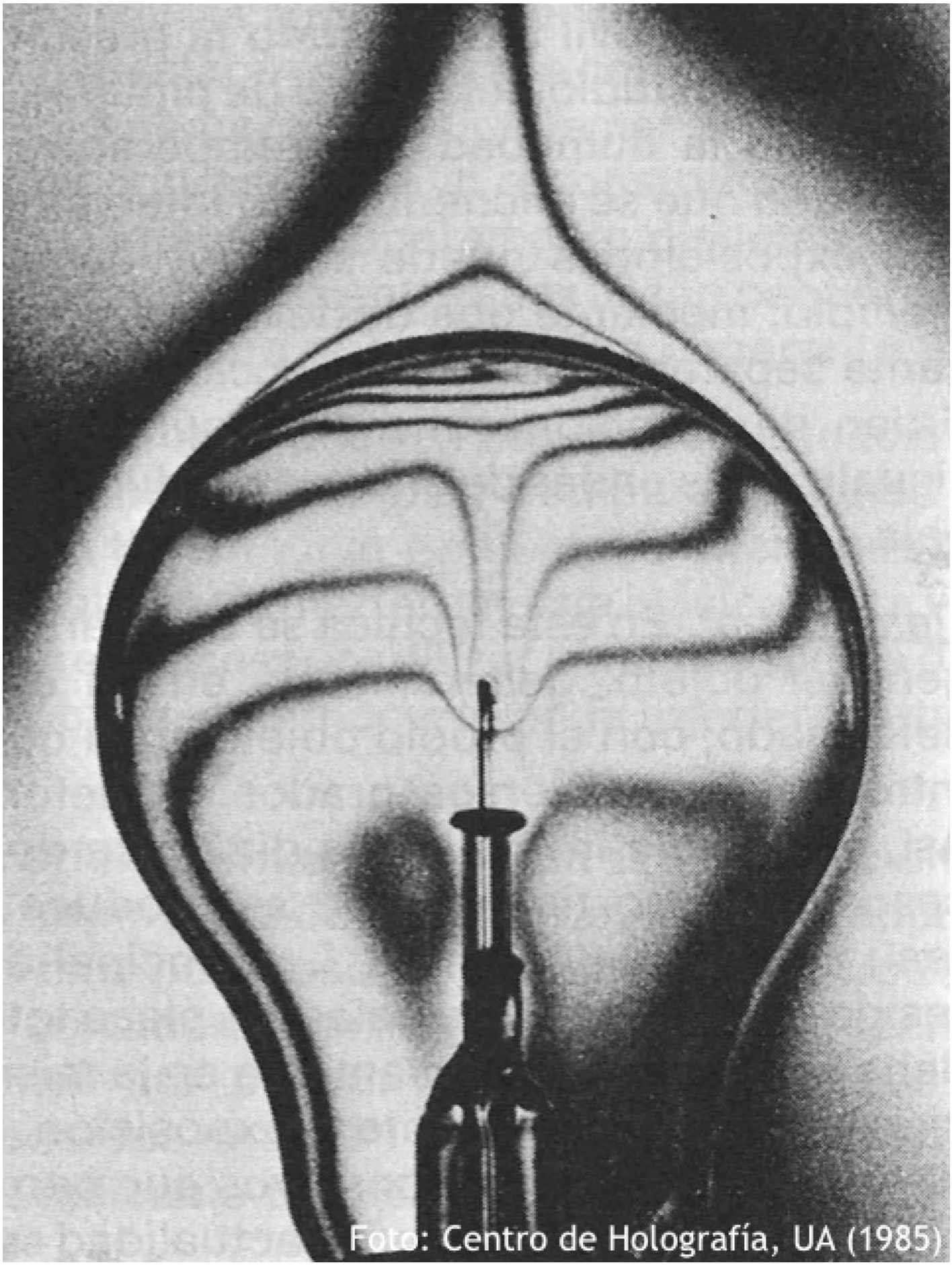
Next comes the year 1865, 150 years ago. The same year that Maxwell published his electromagnetic theory of light, **Émile Verdet** (https://fr.wikipedia.org/wiki/%C3%89mile_Verdet) (1824-1866) published *Etude sur la constitution de la lumière non polaris'ee et de la lumière partiellement polaricée*, and was the first to carry out studies on **coherence**, in particular "partial coherence", even before the concept of coherence was introduced. Verdet asked himself: "if sunlight directly illuminates two pinholes in an opaque screen, how close together would the pinholes need to be for the emerging light waves to form interference fringes when superimposed?". He estimated that this distance was approximately 1/50 millimetre. In modern language this small distance is the diameter of the "area of coherence" formed by sunlight on the surface of the earth.

Arriving at the 20th century, it is impossible to compete with the contributions made by Einstein in 1905 but I will however mention something much more modest: the publication of the book *Physical Optics* by the North-American physicist and inventor **Robert Williams Wood** (https://en.wikipedia.org/wiki/Robert_W._Wood) (1868-1955). This book became the classic treatise on the experimental aspects of the subject in its day, and went through three editions. Wood is often cited as being a pivotal contributor to the field of optics and a pioneer of infrared and ultraviolet photography. Wood's Spot, on the dark side of the moon, was named after him since he discovered that, with ultraviolet photography, the area took on a different appearance, reflecting a sulphur deposit previously unknown.

One hundred years ago, in 1915, the German physicist **Arnold Sommerfeld** (https://en.wikipedia.org/wiki/Arnold_Sommerfeld) (1868-1951) extended the atomic model introduced by Niels Bohr two years previously to consider elliptic orbits. This was one of the most important results of the primitive quantum theory, the generalization made independently a hundred years ago by Sommerfeld, Wilson and Ishiwara for multiperiodical systems (Sommerfeld-Wilson-Ishiwara's quantization rules). (https://en.wikipedia.org/wiki/Old_quantum_theory) These quantization rules were accepted thanks in great part to Sommerfeld's spectacular study on hydrogenoid atoms within the framework of the special relativity theory, which provided a theoretical explanation for the fine structure of a hydrogen atom. Sommerfeld also made significant contributions to the mathematical theory of diffraction and although he did not win the Nobel Prize for Physics himself, he holds the record for the greatest number of doctorate students who did: four in total (Werner Heisenberg, Wolfgang Pauli, Peter Debye and Hans Bethe).

(https://light2015blogdotorg.files.wordpress.com/2015/07/fullsizerender.jpg)
Arnold Sommerfeld. Credit: Konrad Jacobs, Oberwolfach Photo Collection

In 1965, fifty years ago, the first articles on holographic interferometry (https://en.wikipedia.org/wiki/Holographic_interferometry) were published at the University of Michigan by various research groups. They were discovered accidentally, similar to the the cosmic microwave background. However, it was **Karl A. Stetson** and **Robert L. Powell** (https://www.osapublishing.org/josa/abstract.cfm?uri=josa-55-12-1593) (two scientists, as in the case of Penzias and Wilson) who explained this phenomenon and published the very first of these articles. This technique is one of the first practical applications of holography and has been of great scientific, technical and industrial interest ever since. Also in 1965 the concept of optical digital recording and playback, predecessor of the compact disc (http://history-computer.com/ModernComputer/Basis/compact_disc.html) (CD), was invented by **James T. Russel** (https://en.wikipedia.org/wiki/James_Russell_(inventor)) (1931-) while working at the Pacific Northwest National Laboratory in Richland (USA). This is an example of a technological application of light like that of optical fibres used in optical communication.



(https://light2015blogdotorg.files.wordpress.com/2015/07/figure-4a.jpg)
Study of the distribution of temperature inside a bulb using holographic interferometry .
Credit: University of Alicante

This little "game" of searching for other anniversaries of the science and technology of light to commemorate in 2015 has brought to light just a small sample of the numerous people who since the beginning of time have tried to unravel the mysteries of light and apply their findings to many different areas. Just like other scientific and technological areas, the science and technology of light has its own history and we should remember at least some of the "great names" associated with key discoveries that have influenced our way of thinking and living today. What better time to do so than during this "International Year of Light and Light-based Technologies".

(https://light2015blogdotorg.files.wordpress.com/2015/06/figure_5.jpg)Augusto Beléndez (@aubeva) is Full Professor of Applied Physics, leader of the Group of Holography and Optical Processing and Director of the University Institute of Physics Applied to Sciences and Technologies at the University of Alicante of Spain. He is mainly interested in holography, holographic recording materials, holographic optical elements, optical storage, and the teaching of physics and engineering. He is a member of the Spanish Optical Society (SEDOPTICA), Royal Spanish Society of Physics (RSEF), and European Optical Society (EOS). He is Senior Member of the International Society for Optics and Photonics (SPIE) and the Optical Society of America (OSA).

He is active in public outreach: he has published numerous articles in popular science journals, and in the media. In 2009 he started the blog "Física para tod@s (http://blogs.ua.es/fisicateleco)", and he has given some talks to general public on science.

2015, ANNIVERSARIES, OPTICS, PHOTONICS BIOT, DIFFRACTION, GRIMALDI, OPTICAL ACTIVITY, OTHER ANNIVERSARIES, POLARIZATION, POWELL, RUSSEL, SOMMERFIELD, STETSON, VERDET, WOOD

3 thoughts on "Other Anniversaries celebrated during the International Year of Light 2015"

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July 21, 2015 at 8:44 am